P2P Applications Using the Semantic Information Oriented Network

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Abstract

This paper describes P2P applications using an advanced P2P platform called SIONet. Based on its metadata-based routing and easy communication creation capabilities, various kinds of P2P applications can be constructed. Effective discovery, P2P content delivery with digital rights management, semi-active information exchanging community, and P2P ad hoc community are constructed. These are expected to be bases for next generation ubiquitous applications.

1. Introduction

We have been engaged in the fundamental research and software development of an advanced P2P platform and its applications as reported in [1]. This platform, called Semantic Information Oriented Network (SIONet), provides metadata-based routing and community creation capabilities as shown in Fig. 1. This paper describes some P2P applications making best use of these capabilities.

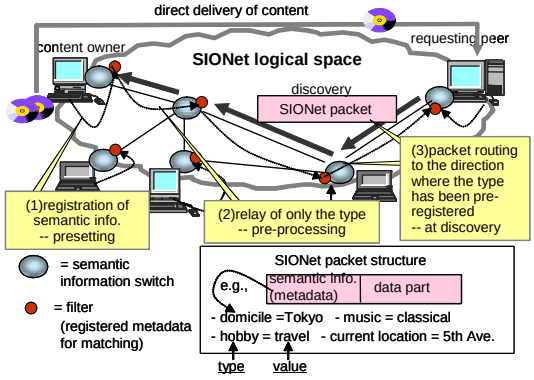

Fig. 1 The SIONet model

2. Metadata-based discovery

SIONet relays metadata in the course of a peer's discovery action. The metadata has a structure of semantic-information types and their value(s). When a new type is registered, the existence of this new type is informed to the other switches. This action tells each switch within the community the direction in which the peer holding the new type is located. In the discovery phase, when a switch receives a discovery packet, it selectively relays the packet in the appropriate neighbouring switches in which the requested semantic-information type has been registered. In this relaying action, each switch checks whether or not it holds the designated data values under the designated type, and lets the service application know of the arrival of a discovery packet. This mechanism leads to fewer discovery packets than in Gnutella. As shown in Fig. 2, SIONet can send a packet to about 1000,000 peers (candidate) within about 200ms. The packet is received only by appropriate candidates that have already registered the type of metadata they want, although Gnutella only broadcasts packets to neighbouring peers (but the propagation time is less).

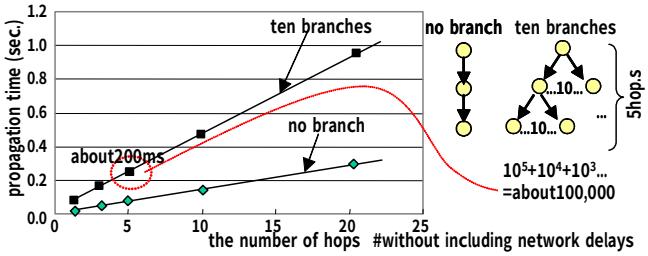

Fig. 2 Propagation time of the SIONet tree

3. P2P digital rights management

File-sharing P2P systems, like Gnutella, offer an easy and quick way of directly exchanging files or contents. However, such systems have made P2P infamous for copyright infringement, blinding many people to the many advantages of P2P technology.

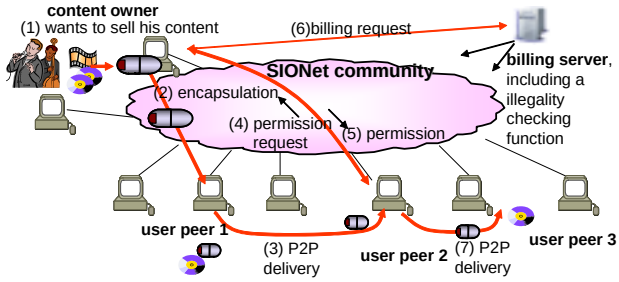

Fig. 3 P2P DRM using SIONet

Fig. 3 is our approach to protect the copyright of content [2]. A content owner first encapsulates his content with necessary information such as the number of times by which users can view it. This capsule is viewed only through a proprietary browser and cannot be opened without his permission. Then, the capsule is delivered to a requesting peer in the P2P mode, and this peer (user) asks the owner for permission. If the user intends to pay for the content (e.g., by a credit card), the owner returns the

permission. On receipt of the permission, the user can view the content. Until the specified time is reached, the content can be relayed to another peer.

4. Semi-active information emission

Fig. 4 shows a community support system that can reflect each peer's preferences. It promotes users to exchange information and content, based on properties predefined by the users and data that are input through the form of a diary (a set of items for a community topic that can be easily selected or input). Metadata for the input data are automatically registered to SIONet while the content itself is contained in each PC. In addition to this semi-active information emission capability, our system also has a direct communication function (instant messaging, etc.).

We examined and clarified the effectiveness of our system by running a wine devotee community for several months. We monitored the behaviour of two types of members, i.e., the active members, who always emit a lot of information from their own home pages or bulletin boards, and the read-only members, who mainly read web pages without writing their own opinions. Fig.5 shows that the read-only members emit about the same amount of information as that of the active members through the semi-active mode (Fig.5 (b)) while they emit much less information during the direct communication mode (Fig.5 (a)). This means that the proposed semi-active information emission mechanism promoted the community activities or reduced barriers of read-only members.

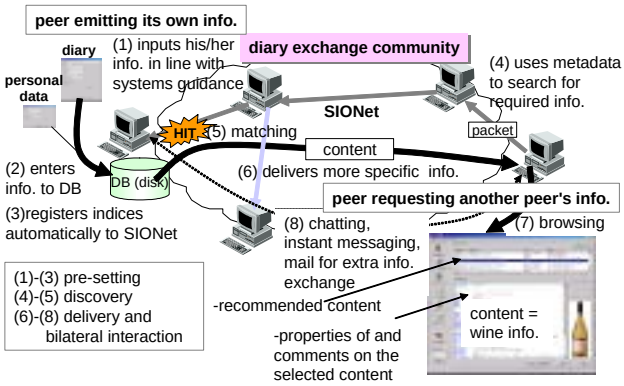

Fig.4 Semi-active information exchange community

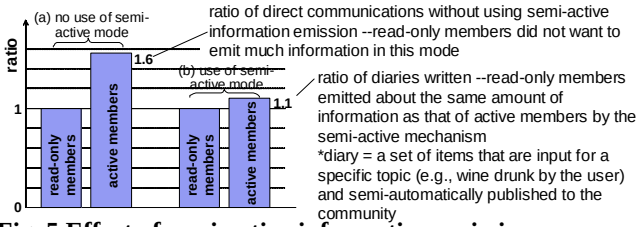

Fig. 5 Effect of semi-active information emission

5. P2P ad hoc community

We implemented the SIONet functions over the ad hoc communication mode [3]. This application can create, for example, an ad hoc shopping promenade, where shops can send advertisements, shopping information, or coupons to nearby customers based on metadata routing (in accordance each customer's preferences) without needing expensive communication equipment. Of course customers can ask information about shops and goods by the metadata routing.

In this community (Fig. 6), SIONet switches are installed in mobile terminals and packets are relayed in accordance with metadata representing each peer's properties or preferences. If a match is made, the user application is notified and the packet is further routed to other peers. Although connectivity between some peers may be lost during movement, most communication between peers will be maintained by multi-hop routing on the SIONet level via other terminals. However, in such a case, the P2P-level topology may become complicated, leading to redundant data transmission in the ad-hoc IP layer (throughput decrease). We implemented topology control functions to optimise both the layers [3].

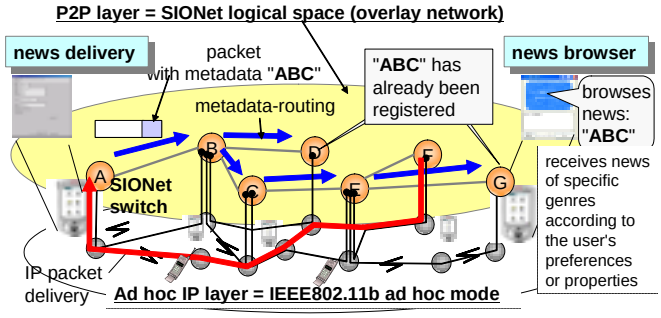

Fig. 6 P2P ad hoc community based on SIONet

6. Conclusion

This paper introduced some P2P applications using SIONet. We are now extending the platform and applications to be bases for ubiquitous applications.

References

[1] H. Sunaga, et al., "Applications using an Advanced Peer-to-Peer Platform" , IEEE International Conference on Peer-to-Peer Computing, Sep. 2003

[2] T. Iwata, T. Abe, K. Ueda, and H. Sunaga, "A DRM System Suitable for P2P Content Delivery and the Study on its Implementation", IEICE APCC 2003, Sep. 2003

[3] K. Ueda, S. Miyazaki, T. Iwata, H. Nakamura, and H. Sunaga, "Peer-to-Peer Network Topology Control within a Mobile Ad-hoc Network", IEICE APCC 2003, Sep. 2003